Time and space scale adaptive whitening as visual dynamic attentional mechanism

Doctoral Meeting initiative (CITIUS)

Víctor Leborán Alvarez

victor.leboran@usc.es
Centro de Investigación en Tecnoloxías da Información
CITIUS, University of Santiago de Compostela, Spain
http://citius.usc.es/.../?victor.leboran

PhD supervisors:
Xosé R. Fdez-Vidal and Xosé M. Pardo

Outline

What is this thesis about?

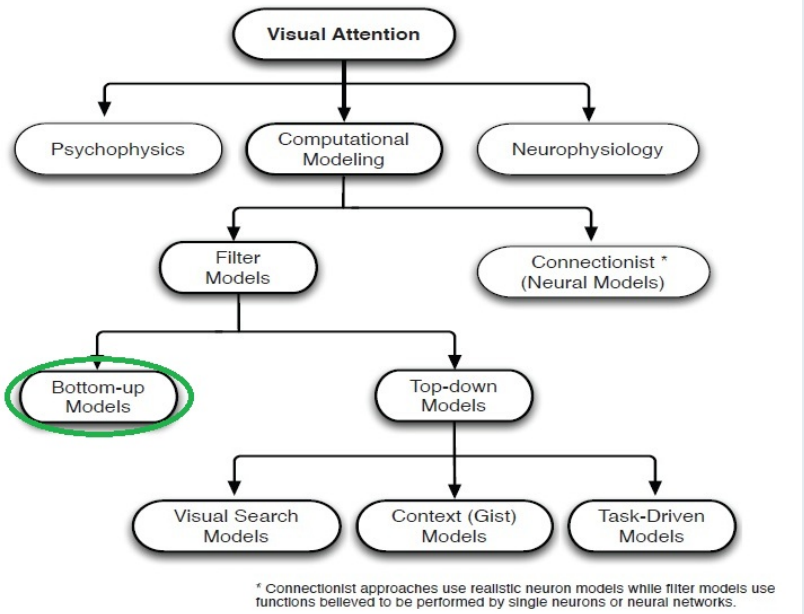
Detecting salient events on scenes

Interest in visual attention

Magic tool ...

Interest in visual attention

Visual attention models



Applications

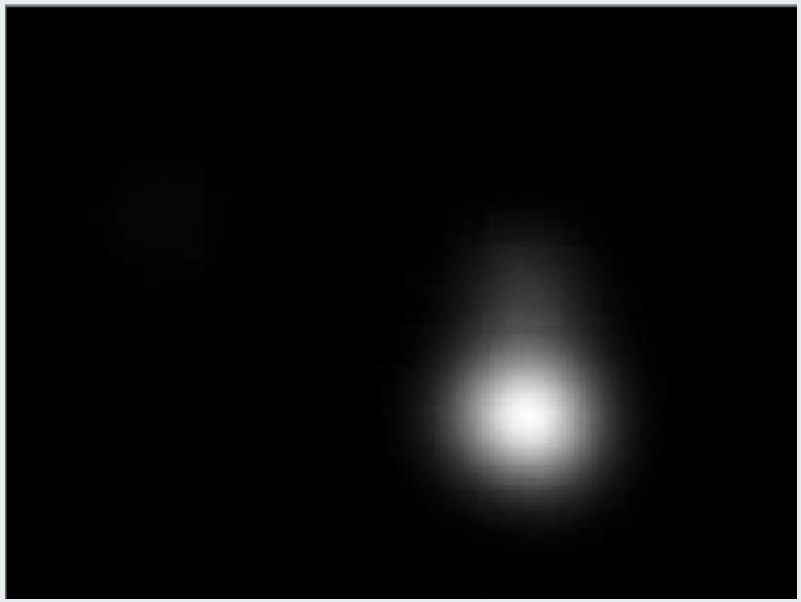
Computer Vision and Graphics	Image segmentation	Mishra and Aloimonos, 2009, Maki et al., 2000
	Image quality assessment	Ma and Zhang, 2008, Ninassi et al., 2007
	Image matching	Walther et al., 2006, Siagian and Itti, 2009, Frintrop and Jensfelt, 2008
	Image rendering	DeCarlo and Santella, 2002
	Image and video compression	Ouerhani et al., 2003, Itti, 2004, Guo and Zhang, 2010.
	Image thumbnailing	Marchesotti et al., 2009, Le Meur et al., 2006, Suh et al., 2003
	Image super-resolution	Jacobson et al, 2010
	Image re-targeting (thumbnailing)	Setlur et al., 2005, Chamaret et al., 2008, Goferman et al., 2010, Achanta et al., 2009, Marchesotti et al., 2009, Le Meur et al., 2006, Suh et al., 2003
	Image superresolution	Sadaka and Karam, 2009
	Video summarization	Marat et al., 2007, Ma et al., 2005
	Scene classification	Siagian and Itti, 2009
	Object detection	Frintrop, 2006, Navalpakkam and Itti, 2006, Fritz et al., 2005, Butko and Movellan, 2009, Viola and Jones, 2004, Ehinger et al., 2009.
	Salient object detection	Liu et al, 2007, Goferman et al. 2010, Achanta et al., 2009, Rosin, 2009.
	Object recognition	Salah et al., 2002, Walther et al., 2006 and 2007, Frintrop, 2006, Mitri et al., 2005, Gao and Vasconcelos, 2004 and 2009, Han and Vasconcelos 2010, Paletta et al., 2005.
	Visual tracking	Mahadevan and Vasconcelos, 2009, Frintrop, 2010
	Dynamic lighting	Seif ElNasr, 2009
	Video shot detection	Boccignone et al., 2005
	Interest point detection	Kadir and Brady, 2001, Kienzle et al., 2007.
	Automatic collage creation	Goferman et al., 2010, Wang et al., 2006.
	Face segmentation and tracking	Li and Ngan, 2008
Robotics	Active vision	Mertsching et al., 1999, Vijaykumar et al., 2001, Dankers, 2007, Borji et al., 2010
	Robot Localization	Siagian and Itti, 2009, Ouerhani et al., 2005
	Robot Navigation	Baluja and Pomerlau, 1997, Scheier and Egner, 1997
	Human-robot interaction	Breazeal, 1999, Heidemann et al., 2004, Belardininelli, 2008, Nagai, 2009, Muhl, 2007
	Synthetic vision for simulated actors	Courty and Marchand, 2003
Others	Advertising	Rosenholtz et al. 2011, Liu et al., 2008
	Finding tumors in mammograms	Hong and Brady, 2003
	Retinal prostheses	Parick et al., 2010

Outline

The brain as a guide

Original Image and fixes

Probability map



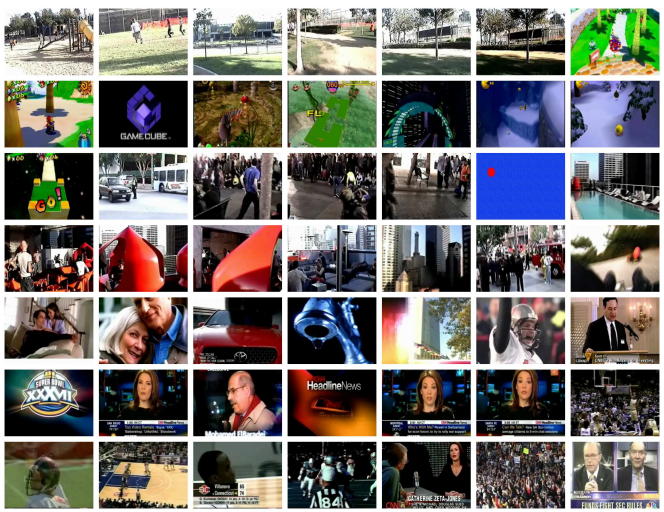
- ▷ Data (Video databases with subject fixations information).
- ▷ Model (Tries to reproduce the visual human behavior).
- ▷ Mathematical tools, that allow us the comparison.

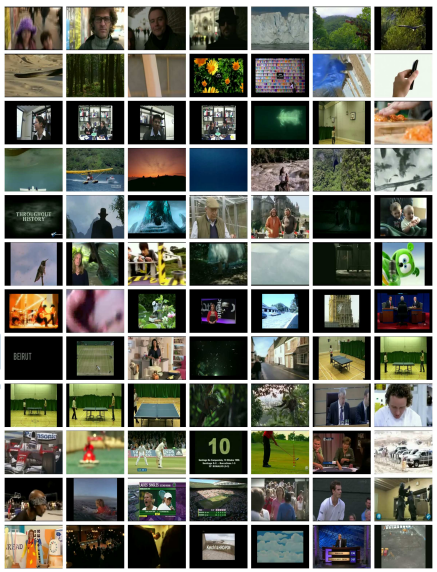
Outline

Data, Model and Math tools

Data

- Video databases with subject fixations information.
  1. CRCNS. (L. Itti y col.)
  2. CARPE. (DIEM project)
  3. USC. (GVA, V. Leborán, X.M. Pardo and X.R.Fdez. Vidal.)

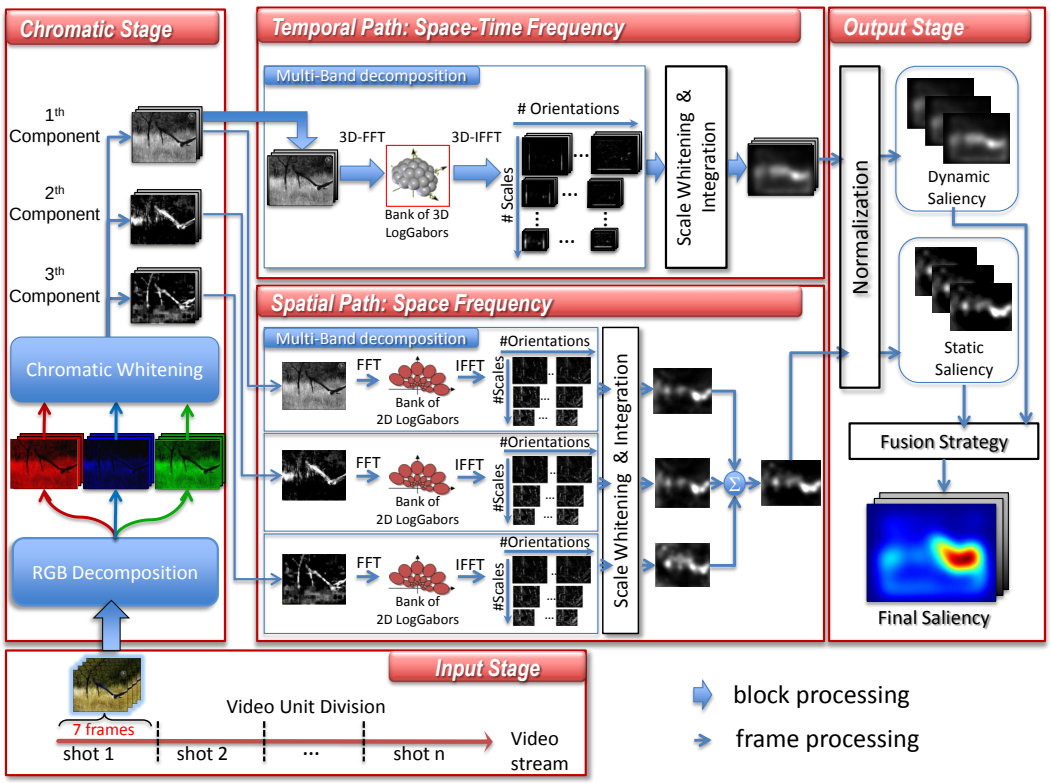




Data, Model and Math tools

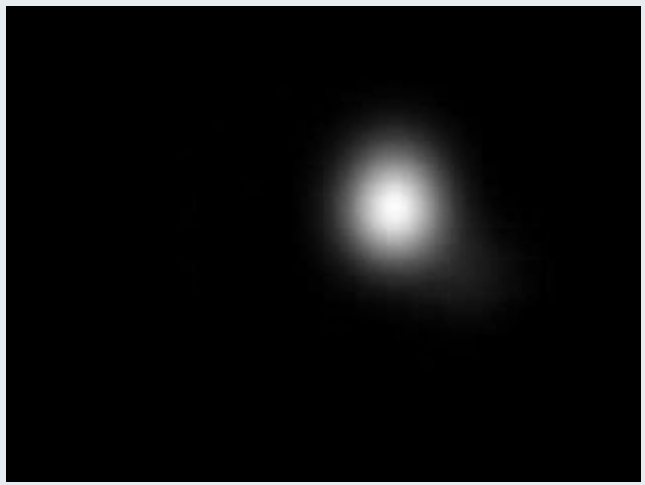
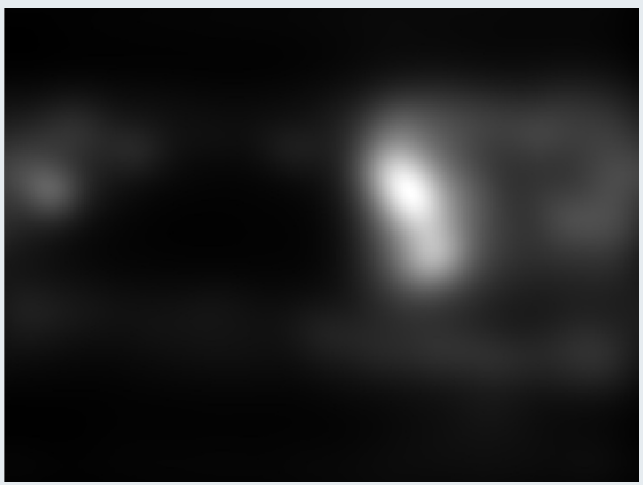
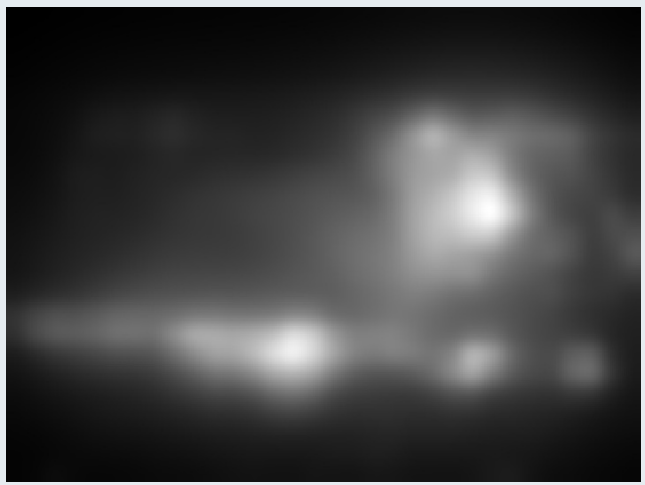
AWS-D Model

- Bioinspired model that tries to reproduce the human behavior during free viewing tasks.



Data, Model and Math tools

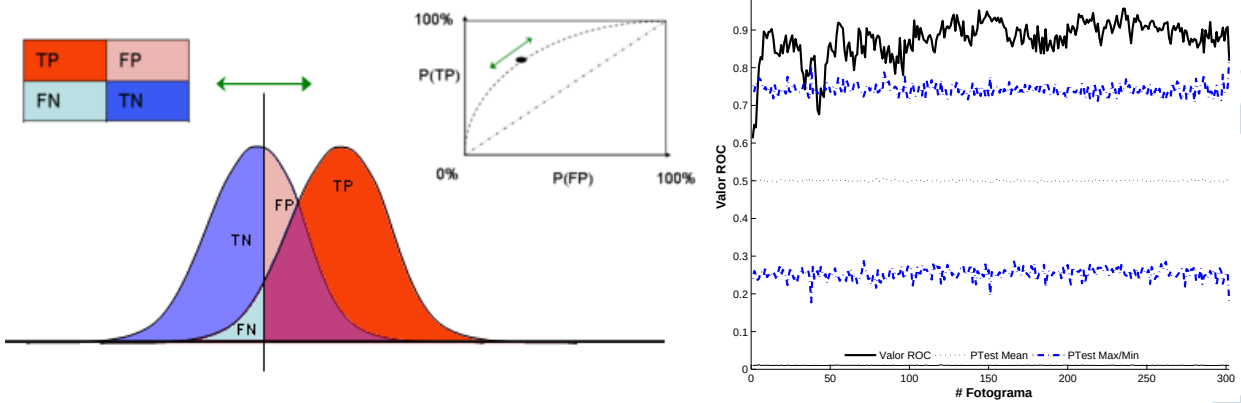
Compare maps...

Data, Model and Math tools

Math tools

- Mathematical tools, that allow us the comparison.
  - Receiving Operator Characteristic (ROC)
  - Kullback Liebner Distance (KLD)
  - Correlation coefficient (CC)
  - ...



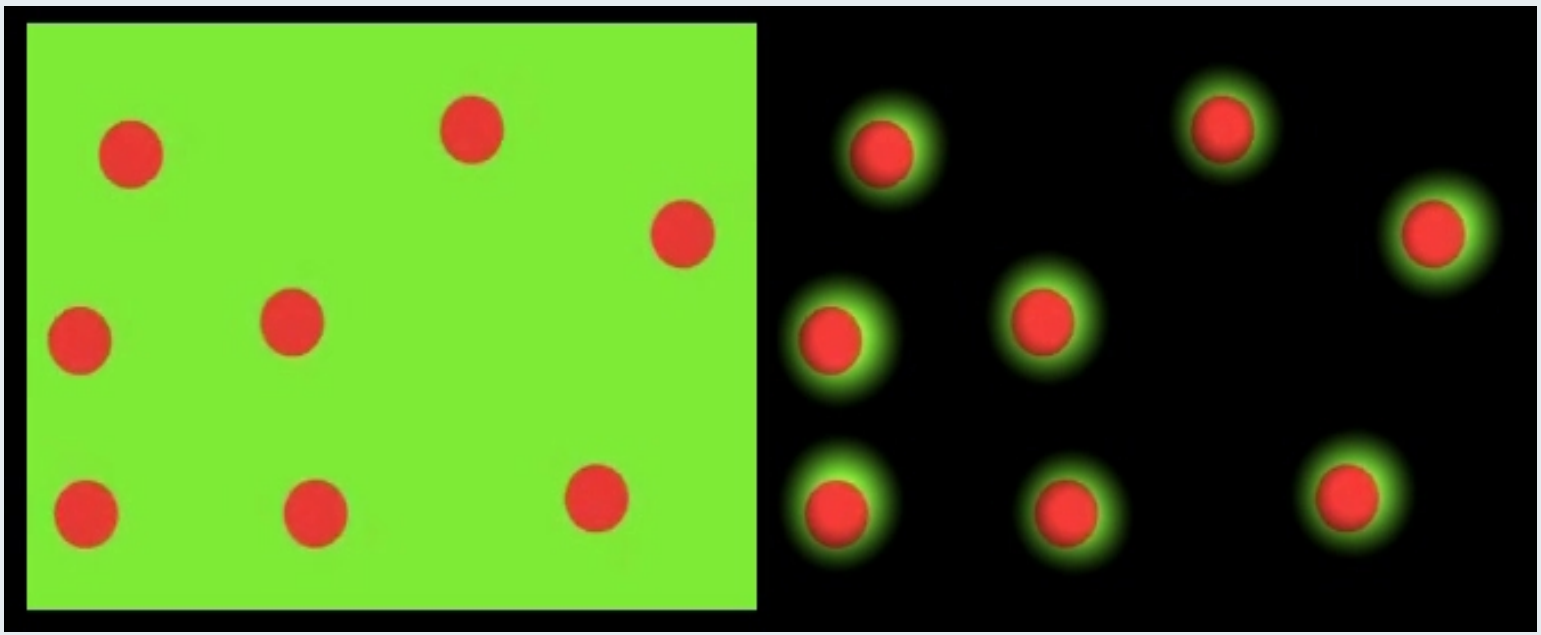
Outline

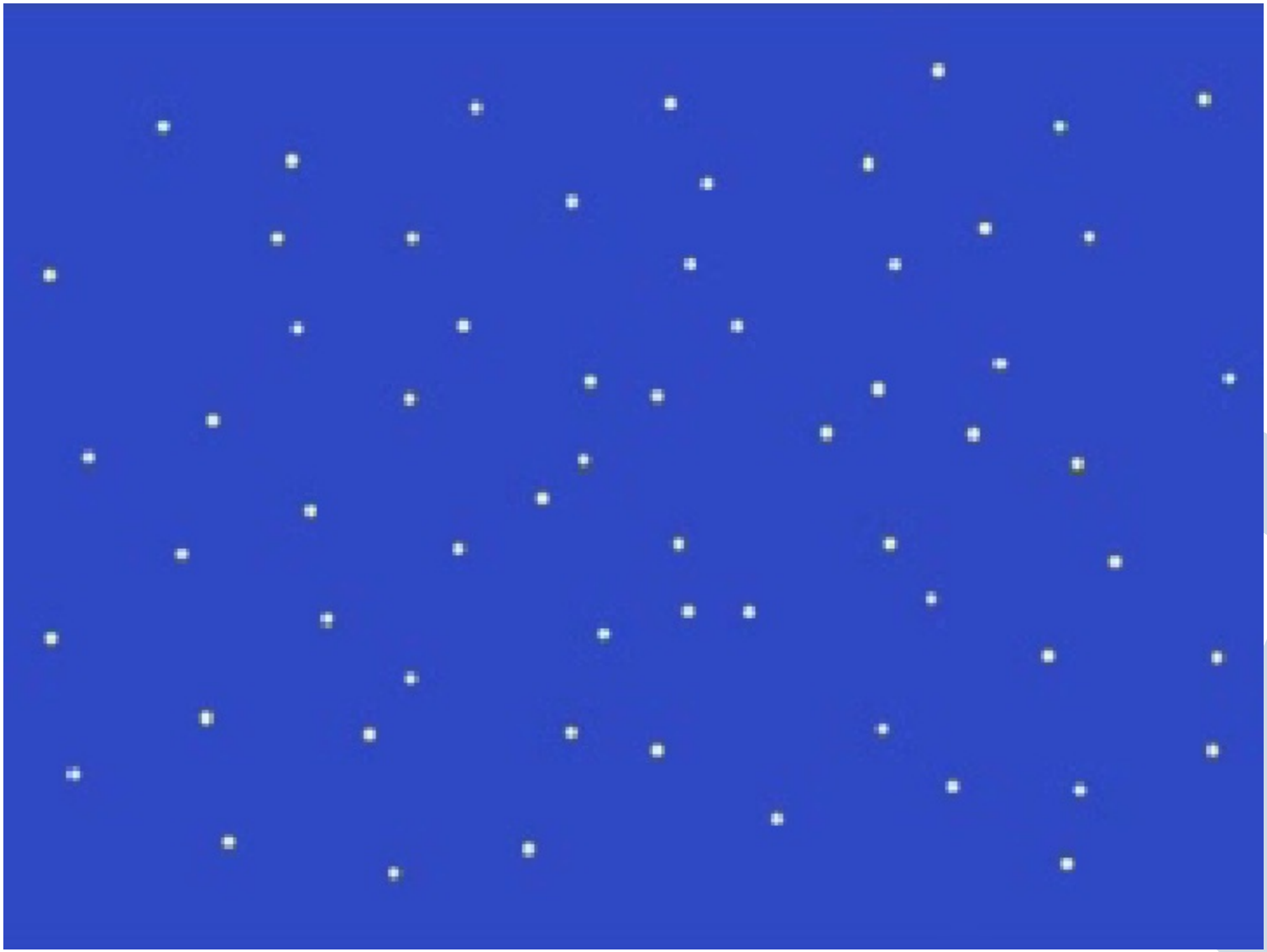
Qualitative results

Natural Video

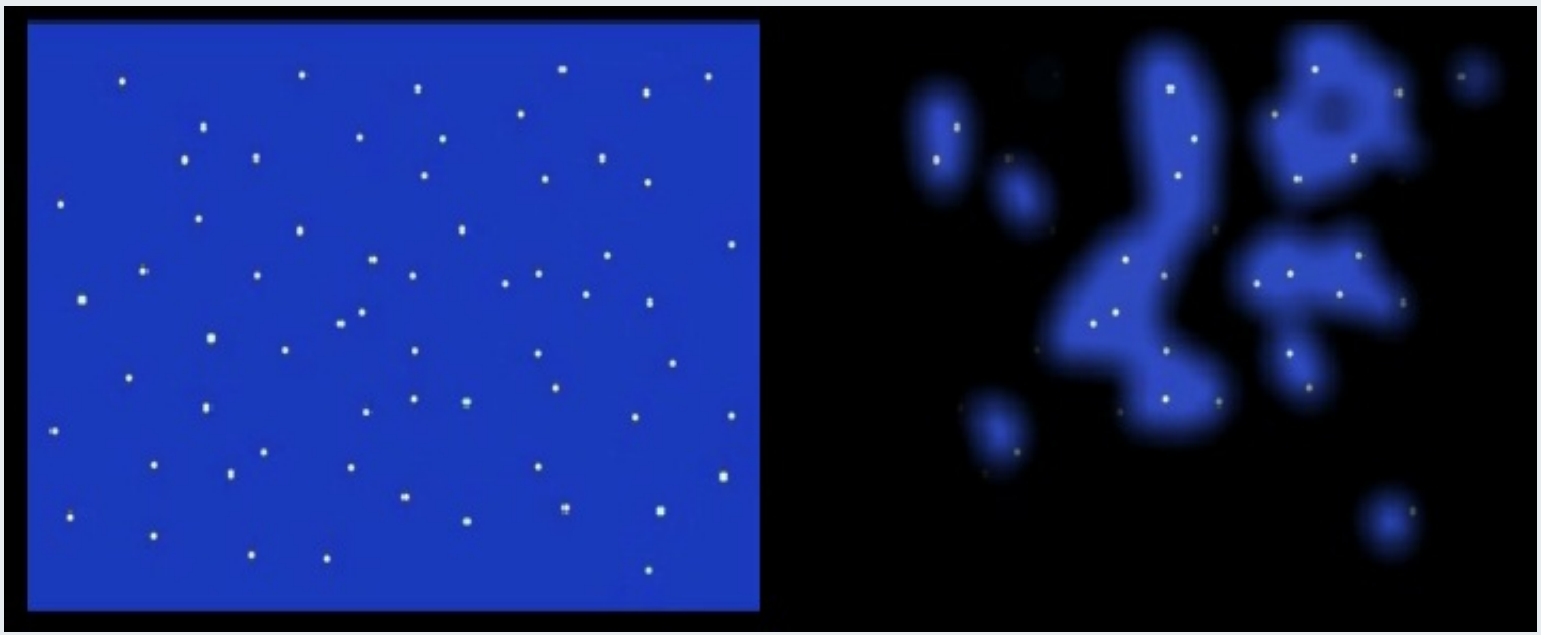
Qualitative results

Synthetic Video



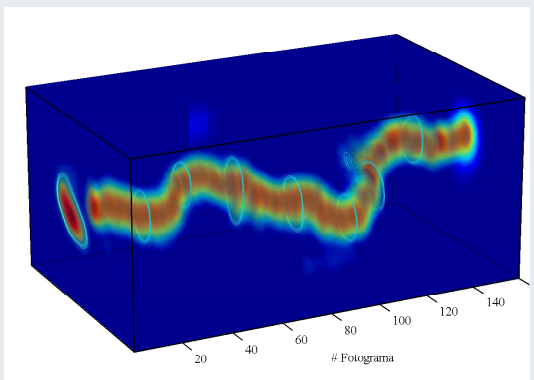


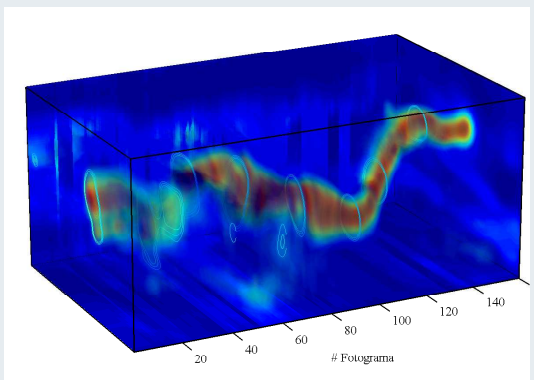
Qualitative results



Qualitative results

3D - Representation





Objective results

ROC metric Results

Test Model	USC-VDB ROC±1 sd	%UT	%LT	DIEM-DB ROC±1 sd	%UT	%LT
AWS-D	**0.81 ± 0.13**	78.6	0.1	**0.66 ± 0.16**	58.9	4.6
GBVSmotion	0.76 ± 0.15	63.7	0.6	0.63 ± 0.17	51.3	6.4
SUNDAY	0.76 ± 0.13	63.8	0.1	0.65 ± 0.13	55.6	2.1
SEOD	0.73 ± 0.15	60.1	0.5	0.62 ± 0.14	41.5	4.0
ITTI-VARIANCE	0.71 ± 0.12	50.7	0.2	0.59 ± 0.13	38.0	3.6
ITTI-SURPRISE	0.70 ± 0.15	52.2	1.0	0.61 ± 0.15	44.8	6.4
ITTI-CIOFM	0.68 ± 0.13	47.0	1.8	0.60 ± 0.14	46.0	5.7
HUMAN-IO	0.85 ± 0.08	88.5	0.0	0.82 ± 0.10	94.1	0.0
GAUSS	0.50 ± 0.20	13.7	12.4	0.50 ± 0.19	27.1	24.6

Outline

Improvements

to do...

- Optimize parameters.
- Write a journal article with a detailed description.
- Test with more public databases.
- Integrate with top-down strategies.

Outline

Publications

JCR Journals

1. J. Pardo-Vázquez, V. Leborán and C. Acuña. “Neural correlates of decisions and their outcomes in the ventral premotor cortex". The Journal of Neuroscience, 28(47):12396-12408, 2008.
2. J. Pardo-Vázquez, V. Leborán and C. Acuña. “A role for the ventral premotor cortex beyond performance monitoring". Proceedings of the National Academy of Science USA, 106(44):18815–9, 2009.
3. J.T. Maringwa, C. Faes, H. Geys, G. Molenberghs, C.Cadarso-Suárez, J.L. Pardo-Vázquez, V. Leborán, and C. Acuña. “Application of penalized splines in analyzing neuronal data.”, Biometrical Journal, 51(1):203–216, 2009.
4. Antón García-Díaz, Víctor Leborán, Xosé R. Fdez-Vidal, and Xosé M. Pardo. “On the relationship between optical variability, visual saliency, and eye fixations: A computational approach.”, Journal of Vision, 12(6), 2012.

Publications

Conferences

1. Víctor Leborán, Antón García-Díaz, Xosé R. Fdez-Vidal, and Xosé M. Pardo. "Dynamic Saliency from Adaptative Whitening", Sent to IbPRIA 2013 (Under revision).

Other...

1. C. Acuña, J. Pardo-Vázquez, and V. Leborán., "Decision-making, behavioral supervision and learning: An executive role for the ventral premotor cortex". Neurotoxicity Research, 18:416–427, 2010.

Thank you very much!!